

Space Weather Technical Forecast

Issued on Sunday 1 December 2024 at 12:25 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of isolated M-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with only low C-class flares observed. There are eight sunspot regions currently on the visible disc, the largest of which are AR3905 and AR3906 in the southwest. However these are magnetically relatively simple and have been largely inactive. The next most notable is AR3912 in the southeast, which is a small east-west aligned region, but also a relatively simple and currently inactive bipolar group.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Slow wind conditions prevailed with solar winds speeds, measured by ACE at L1, background to slightly elevated, ranging 350-440km/s. Density was mainly below or at average. Total Interplanetary Magnetic Field (IMF) strength, Bt, was Weak to Moderate 5-11nT with north-south component (Bz) also Weak to Moderate. This was mainly northward directed, peaking 11nT, with only brief southward spells, with minimum -8nT. Phi angle was initially negative (towards the Sun), but then rotated to be positive from 01/0600 (away from the Sun). Geomagnetic was Quiet (Kp0-2).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was Background. The associated 24-hour fluence remained well below Active. The 01/0000 UTC observed was 1.18e6 total pfu.

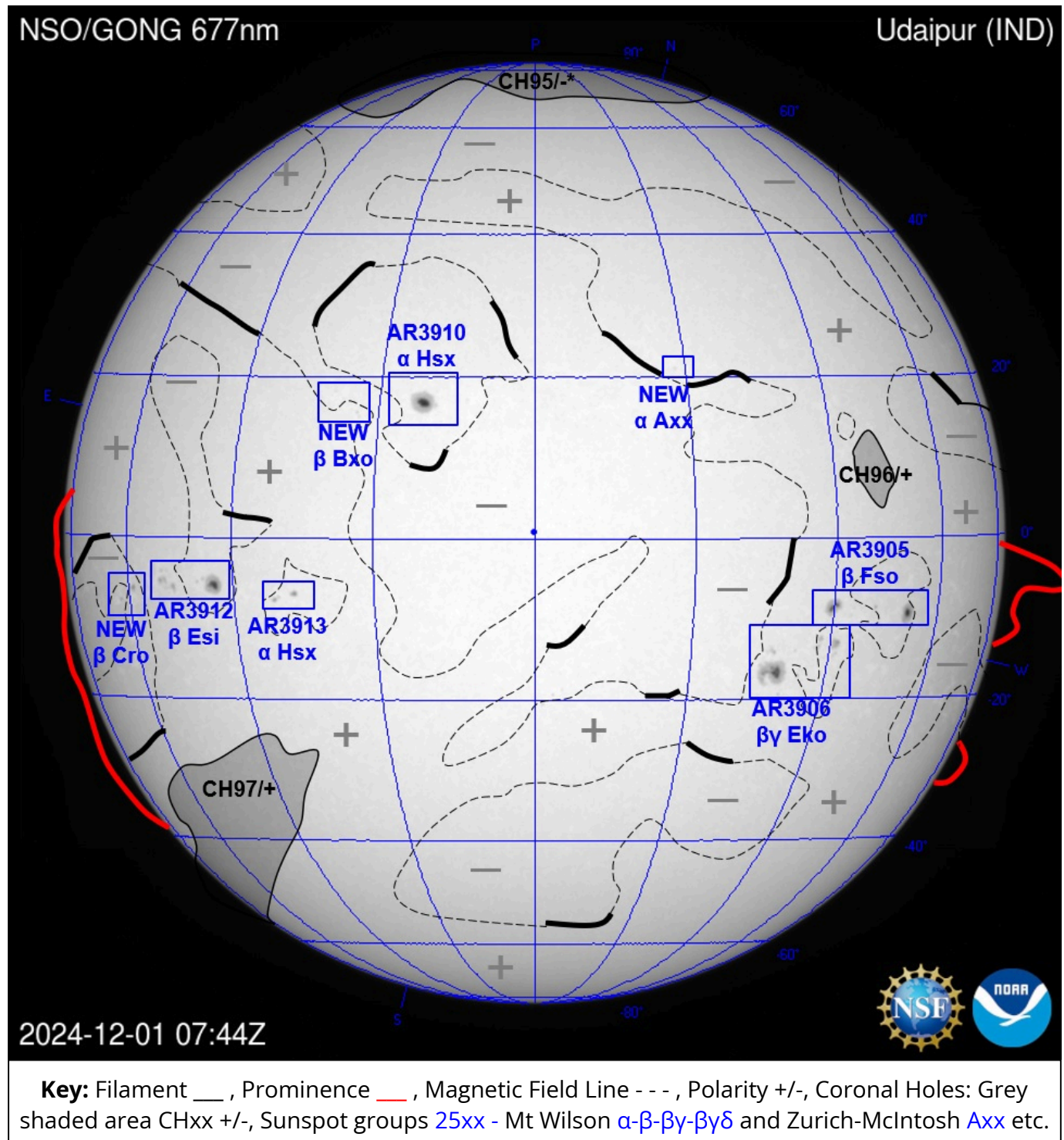
Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A slow CME from a filament eruption on 27 Nov has a chance of a glancing impact on Day 2 (02 Dec) or early Day 3 (03 Dec), however only limited enhancements are likely. Any enhancement from CH96/+, which may occur alongside this, is expected to be minimal with mainly background to slightly elevated solar winds persisting throughout. Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals. Any CME or coronal hole enhancement day 2-3 (02-03 Dec) brings a chance of an Unsettled Active spell and a slight chance of G1/Minor Storms.

Energetic Particles / Solar Radiation: High energy protons are expected to persist at background with only a slight chance of responding as a result of any notable flare activity. High energy electron flux is expected to persist mainly at background with the associated 24 hour fluence remaining below the Active threshold.

Figure 1: Solar Synoptic Map 01/0800 UTC



Geomagnetic Storms

A weak CME, due to a filament eruption off the southeast disc around 27/1900 UTC, has a chance of giving a weak and glancing impact, most likely during the second half of day 2 (02 Dec), perhaps early day 3 (03 Dec). However any impact is expected to be limited, perhaps bringing Unsettled to Active geomagnetic conditions, and only a slight chance of G1 Minor Storms.

Otherwise slow winds are expected to mainly continue throughout, with background to slightly elevated speeds. While there is small coronal hole, CH94/+, evident in GOES SUVI-195 imagery, this is a very small and low confidence feature, and may also just allow for a brief spell of weak enhancement on day 2-3 (02-03 Dec), perhaps peaking around 450km/s. MOSWOC Enlil is currently slightly over-estimating the background winds, but supports slow wind conditions persisting through the period

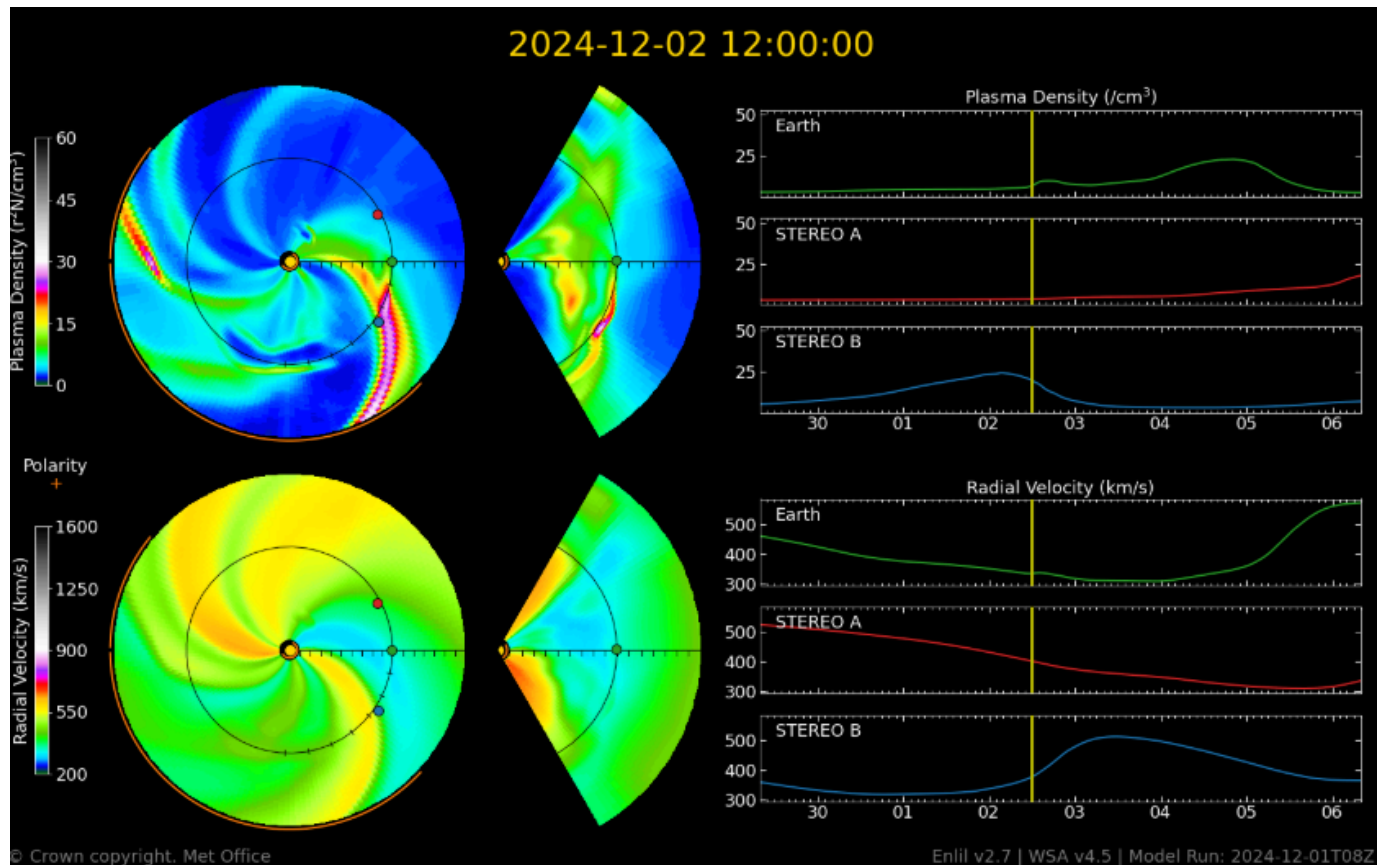
Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals throughout. Any CME or coronal hole enhancement day 2-3 (02-03 Dec) brings a chance of an Unsettled Active spell and a slight chance of G1/Minor Storms.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	10	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R $\odot$ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
28/11/2024 04:28	Partial	Filament	SE	390	02/12/2024 14:00 UTC	Moderate confidence of a glancing blow. Minimal enhancement expected.

Figure 2: Enlil showing easing solar winds, and the slight glancing CME arrival on 02 Dec.



Radio Blackouts - X-Ray Flares

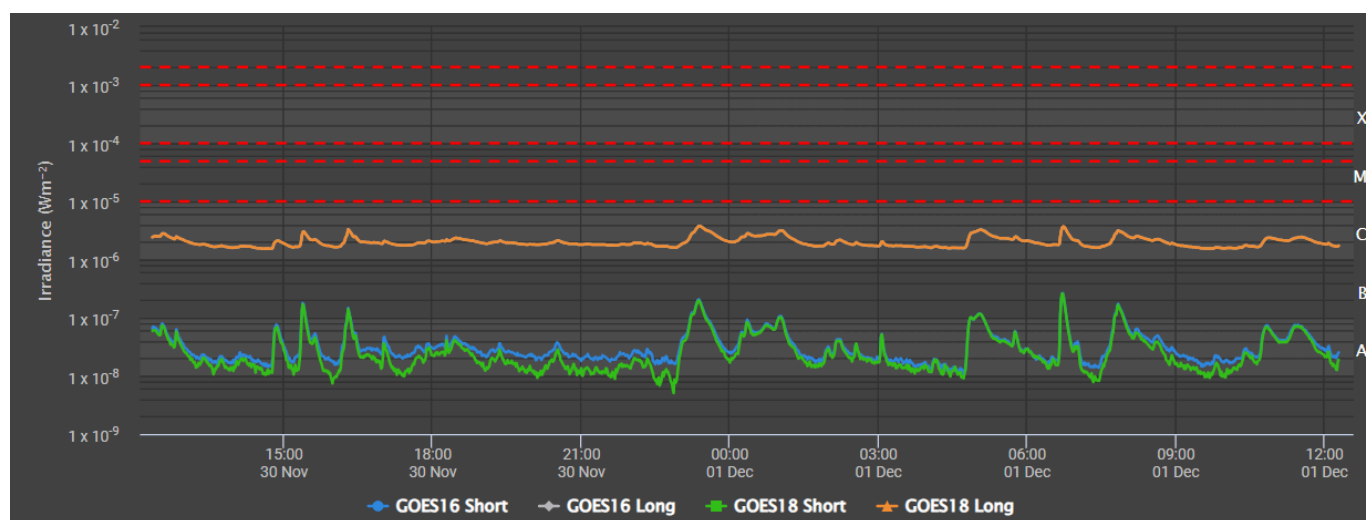
Low to Moderate activity is expected with a chance of isolated M-class flares with the majority of the sunspots on the disc currently small and magnetically simple.

The main exceptions are AR3905 and AR3906, which form a moderately sized cluster in the southwest disc, and AR3912 in the southeast. Of these AR3906 is perhaps the most complex, with a slightly more twisted magnetic structure, and a large trailer spot. While AR3905 is a simpler open and mature group, this is close enough to AR3906 to have some magnetic connection and slightly increase the complexity on this portion of the disc. Despite this, these both remain inactive regions. AR3912 in the southeast is showing some increasing areal extent, however this remains a broadly simple bipolar group, with a north-south aligned polarity separation line, limiting the potential for notable flares. Some magnetic looping is evident on the east limb of GOES SUVI 304 and 171, which could relate to oncoming regions, with a number of old regions expected to return during the coming days. However far-side GONG products have very little signal for any notable regions returning.

Please note, assessment of sunspot regions is currently more challenging than usual as JSOC/Stanford was affected by significant flooding on 2024-11-26 resulting in a prolonged outage of available data.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	40	40	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 3: GOES-16/18 X-ray Irradiance



Solar Radiation Storms (High Energy Protons)

GOES-18 Proton flux is currently at background. While there are a couple of moderately sized regions on the better connected western disc, these are relatively simple and have remained inactive. Along with the other regions on the disc also being relatively small and simple, this only gives a slight chance of high energy proton enhancement through this period.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	10	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

High Energy Electrons ($\geq 2\text{MeV}$)

High energy Electron flux observed by GOES-16 is at Background. This is expected to persist, with no significant coronal hole or CME enhancements currently anticipated during the forecast period.

The associated 24 hr fluence is expected to persist below Active levels, with MOSWOC REFM currently considered to be providing good guidance.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1\times10^8$	No	1	1	1	1
Very Active	$\geq 2\text{ MeV}$ $\geq 1\times10^9$	No	1	1	1	1

Figure 4: GOES 16 Electron Fluence and REFM

